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The World Economy

INVITED REVIEW

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A Triangular Purchasing Power Parity Hypothesis: a rejoinder
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We are delighted to see Dr Alan King’s (King, 2021, AK thereafter) interest and curiosity in the subject of PPP and, in particular, this paper of ours (Wang & Liu, 2018). AK spends the first half of his paper going though and explaining our paper. So, we jump to and start with his critique of the triangular PPP hypothesis where he raises three points.

3(i)

The first argument of AK is that “aspects of its theoretical framework are either implausible, inconsistent or incomplete”. This strong statement is based on somewhat perplexed misunderstandings, the three important assumptions AK assumes we make. The argument seems to be based on incomplete information too. There are five, instead of three, equations for introducing GT PPP, and equation (3) is interim to reach equation (5). Our explanation and discussion start below equation (5):

“The above relationship tells that inflation in the Euroland would be influenced more by the inflation of the economies that possess greater gravity and momentum, and by the changes in the exchange rates between the euro and the currencies that possess greater gravity and momentum. The influence of small economies is negligible. Similarly, this notion applies to the US dollar, the RMB and other currencies” (p. 3075).

While AK interprets:

“The first is that small economies have a negligible role to play in the GT PPP relationship. This assumption is plausible in relation to an individual small economy.
For example, goods produced in Chile account for a tiny share of Euroland’s consumption bundle and so, naturally, inflation in Chile and fluctuations in the value of its peso against the euro should have almost no impact on Euroland’s inflation rate. However, when moving from equation (1) to the tripolar expression of GT PPP, equation (2), WL assume that such economies are collectively irrelevant. This is a nontrivial assumption, as most of the gravity and momentum measures WL provide indicate that the rest of the world as a whole is as important as one of the three big economies’.

A key point to develop into a triangular PPP through GT PPP and tripolar GT PPP, which begins with equation (6) after presenting the factual figures in Table 1 and Table 2 (cf. Wang & Liu, 2018), is that the economy should be sufficiently large to substitute the US economic variables. Similarly, when this notion applies to the US dollar, then the economy to substitute Euroland economic variables should be sufficiently large. That “such economies are collectively irrelevant” is not assumed in our study; it is irrelevant. Use the example of AK, Chile (rather not to use any country to stand for a small economy here. And the Chilean peso is free floating according to the IMF). Chile is unlikely to enter into a triangular PPP relationship with the US and Euroland, our analytical framework would suggest. The matter is further confounded by additional remarks by AK:

“This assumption is plausible in relation to an individual small economy. For example, goods produced in Chile account for a tiny share of Euroland’s consumption bundle and so, naturally, inflation in Chile and fluctuations in the value of its peso against the euro should have almost no impact on Euroland’s inflation rate”.

AK has based this discussion on equation (1b) in our paper. However equation (1b), which is a standard relative PPP representation, indicates that the peso euro exchange rate would respond to the inflation differentials between Chile and Euroland. No matter how little impact
the Chilean inflation is on Euroland, it is crucial for relative PPP to hold and should not be regarded as being almost no impact.

AK then proceeds to the next point:

“Second, the value of a country’s gravity-momentum function is assumed to be determined by the product of its gravity and its momentum. This assumption is essential to minimising the role of the US variables in equation (2) and the prediction that PPP should hold between China and Euroland, but no justification is provided it. Although it is conceivable that the absence of gravity would ensure that a high-momentum economy plays a negligible role in equation (2), a considerable leap of faith is required to accept that the absence of momentum is sufficient to nullify the gravitational influence of an economy the size of the United States.”

This misinterprets what we write clearly:

“We do not specify the form of the gravity momentum function, which can be the product of gravity and momentum, multiplying the individual effects” (p. 3083).

GT PPP that involves gravity and momentum is a conceptual framework, which helps attain the triangular PPP relationship. It is clear that the gravity momentum function $f_i(G, M)$ is not quantified in this study, which is not intended. This conceptual analytical framework however shows that a considerably large value of the gravity momentum function of an economy, coupled with kinds of pegged or stabilized exchange rate arrangements, makes triangular PPP emerge. The latter is empirically examined in the paper, which is beyond statistical questions.

Our empirical test results do suggest that momentum is dominant over gravity, given the comparable gravities between the three economies but the greater momentum in the PRC variables. To empirically quantify the gravity momentum function $f_i(G, M)$ is beyond the scope of this paper, which merits separate studies.
The third point of AK is interesting and actually quite right:

“Third, although Euroland is the reference economy selected for equation (1), WL state (p. 3075) that the notion of GT PPP can be applied to any other economy. However, if any economy could be the subject of equation (1) – i.e., there is a system of GT PPP equations – this would imply that PPP must hold for all possible pairs of economies”.

We think AK is referring to triangular PPP, his equation (11) seems to indicate. So, “this would imply that PPP must hold for all possible pairs of economies” is “this would imply that triangular PPP must hold for all possible pairs of economies”. Mathematically it is true and right. Other economies possessing the similar size/gravity/momentum and features can make it happen too. But research should be relevant to real world issues and be based on realities, which discussion of the factual figures in Table 1 and Table 2 (cf. Wang & Liu, 2018) has identified.

AK continues:

“This feature of GT PPP creates two difficulties for triangular PPP. First, it implies that the concept of GT PPP can be rejected empirically by evidence that PPP does not hold between any single pair of economies. Second, it contradicts WL’s later argument that PPP is not expected to hold between the United States and either China or Euroland”.

As stated earlier, GT PPP is a conceptual framework, which helps attain the triangular PPP relationship. GT PPP can be developed on its own too in separate studies. Again confusion surfaces: GT PPP or GT PPP equations can be rejected empirically but not the concept of GT PPP. Indeed, the element in equation (5) by the bilateral PPP for the US vis-à-vis Euroland would contribute to the departure from GT PPP in equation (5), when the bilateral PPP between the US and Euroland does not hold, as in our study.
The following query is interesting as well, which is the interpretation of the right hand side of equation (11) of AK that is the right hand side of equation (6b) in our paper:

\[-\Delta e_{$/t} - \frac{f_{PRC}(G, M)}{f_{US+PRC}(G, M)} \Delta e_{$/t}\]

AK ponders:

“Because China’s pegged exchange rate regime limited the size of fluctuations in the renminbi dollar rate, it is argued that $\Delta e_{$/t}$ dominates the fraction of $\Delta e_{$/t}$ and so the latter can be ignored. However, this overlooks the argument made when deriving equation (3) that the value of China’s gravity-momentum function is overwhelmingly greater than that of the United States. Hence, the fraction, $\frac{f_{PRC}(G, M)}{f_{US+PRC}(G, M)}$, should be close to unity”.

AK is right to point out “the fraction, $\frac{f_{PRC}(G, M)}{f_{US+PRC}(G, M)}$, should be close to unity”. However, $\Delta e_{$/t}$ is much smaller than $\Delta e_{$/t}$. The standard deviation of $\Delta e_{$/t}$ is around 25% of that of $\Delta e_{$/t}$, using daily data (for the sample period in the paper), or the standard deviation of $\Delta e_{$/t}$ is 4 times of that of $\Delta e_{$/t}$. Given that CPI/inflation data are monthly and assuming random walks for exchange rates, the standard deviation of $\Delta e_{$/t}$ is 90 or nearly 100 times of that of $\Delta e_{$/t}$. Even if $\frac{f_{PRC}(G, M)}{f_{US+PRC}(G, M)}$ is close or equal to one, the first term in the above dominates the second overwhelmingly. This is another case requires that research be real world issues based, not just mathematical formulae and transformations.
3(ii)

This is the most interesting constructive engagement. AK cites selected extracted paragraphs, which readers can refer to our paper and his paper and are not repeated here. After that AK has concluded:

“Therefore, the mechanism underpinning triangular PPP ignores all the other mechanisms traditionally associated with PPP – e.g., the flow-on effect of rising import prices onto domestic wages and prices, international goods arbitrage, and the need for an economy to achieve a particular level of international price competitiveness over the long term to maintain external balance”.

We pay specific attention to the mechanisms and channels through which triangular PPP emerges, together with the associated factors and their effects. This study of ours goes the extra mile to contemplate the mechanisms and channels of triangular PPP, some of which show unique features and some others involve some in the above. Nevertheless, triangular PPP is not a strategy for achieving international competitiveness for nations.

3(iii)

AK comments on this part of the paper at length:

“Given that the exchange rate between any two currencies can always be inferred from their individual exchange rates against a third currency (i.e., cross-currency arbitrage is not profitable), then equations (7) and (8) are mathematically equivalent. In other words, triangular PPP is merely a rearrangement of the conventional PPP relationship between China and Euroland. …”

AK’s equation (7) and equation (8) are our equation (12) and equation (13). We have stated in the paper (p. 3084) that Mathematically, bringing equation (10) back into equation (13) reproduces
equation (11). However, this mathematical operation is valid if and only if the relationship in equation (10) is upheld. Given a pegged RMB that steadily appreciated against the US dollar, $\ln(e_{¥/S,t})$ is virtually a linear trend, with fluctuations much narrower than those associated with flexible exchange rates. So, equation (13) can be presented as equation (14), where $\delta$ is coefficient, and $\nu_t$ is a random variable with a zero mean, reflecting confined fluctuations in the RMB dollar exchange rate that is much narrower than those associated with flexible exchange rates. It is not surprising that mathematically one (operation, transformation) leads to another and we have emphasized it. Meanwhile, we also emphasize that it is not simply a mathematical operation but beyond. AK merely repeats what we have said but with confounded understanding and misinterpretations.

The above analysis and deliberation resolutely refute the unsubstantiated allegations in bold statements: “First, aspects of its theoretical framework are either implausible, inconsistent or incomplete. Second, the triangular PPP hypothesis is no more than a simple rearrangement of a conventional PPP relationship”.

3(iv) This part is related to “Moreover, some of the empirical evidence presented in support of the triangular PPP actually refutes one of its central ideas” in abstract and “Third, WL’s econometric results do not provide particularly strong support for the hypothesis and, in fact, at least one result represents evidence against its central idea.” on page 11 in AK.

AK remarks:
“To evaluate the empirical evidence for triangular PPP I will focus on WL’s unit-root and Granger causality test results. The results of the cointegration tests are not considered because the coefficient estimates for each cointegrating relationship are not reported”.

The remark shows a lack of knowledge in the empirical PPP literature. One is to test whether there is a cointegration relationship between (the logarithms of) the exchange rate and prices in the two currency zones. i.e., whether a linear combination of the three variables is stationary. The other imposes a proportionate change requirement on the above. These are not our contribution novelty or but have been in the empirical PPP literature for decades. We call the former weak form tests and the latter strong form tests. The former is expressed with equation (11’), equation (12’), equation (13’) and equation (14’). The latter is expressed with equation (11’’), equation (12’’), equation (13’’) and equation (14’’), where proportionate restrictions on the variables are imposed: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha'_3 = -1$, $\beta_1 = \beta_2 = \beta_3 = \beta'_3 = 1$. There is no need to report the coefficients, but the test results for the existence of a cointegration relationship are required. What is new in our paper is triangular PPP, with two variations in testable forms, i.e., standard triangular PPP and simple triangular PPP.

Both standard triangular PPP and simple triangular PPP in their weak form are confirmed by the results in Table 5 (cf. Wang & Liu, 2018), given the established cointegration relationships for all three PRC CPI measures. That is, it is confirmed firmly overwhelmingly by six, and all six different specifications. Whereas the test results in Table 6 (cf. Wang & Liu, 2018) indicate that triangular PPP in the strong form is confirmed by five out of six specifications. A unit root is not rejected for measure 2 of the PRC CPI for simple triangular PPP. The results are highly robust and in line with empirical studies on bilateral PPP that the acceptance rate of strong form PPP is lower than that of weak form PPP.
AK continues:

“WL’s three sets of ADF and PP test results are reproduced in Table 1.8 The first point to note is that the evidence against the null of a unit root is consistently stronger (across all three measures of CPI_{¥,t}) in the case of equation (9) than is the case for equations (7) and (8). However, as discussed in Section 3(iii) above, the only difference between equations (8) and (9) (i.e., standard and simple triangular PPP, respectively) is that the former restricts the coefficient on ln(e_{¥/S,t}) to equal −1, whereas this variable is replaced by a time trend with an unrestricted coefficient (δ) in the latter. The stronger test results reported for equation (9), therefore, are the consequence of relaxing this restriction and so should be given less weight. …

Taken as a whole, these results do not provide a strong basis for concluding that triangular PPP holds, but PPP between the United States and Euroland does not.”.

Both standard triangular PPP and simple triangular PPP in their weak form are confirmed by the results in Table 5 (cf. Wang & Liu, 2018) in our paper, given the established cointegration relationships for all three PRC CPI measures. That is, it is confirmed firmly overwhelmingly by six, and all six different specifications. Whereas the test results in Table 6 (cf. Wang & Liu, 2018) indicate that triangular PPP in the strong form is confirmed by five out of six specifications. A unit root is not rejected for measure 2 of the PRC CPI for simple triangular PPP. The results are highly robust and in line with the empirical studies on bilateral PPP that the acceptance rate of strong form PPP is lower than that of weak form PPP. How can AK conclude “Taken as a whole, these results do not provide a strong basis for concluding that triangular PPP holds”? This is much modest however compared with his words in Abstract “Moreover, some of the empirical evidence presented in support of the triangular PPP actually
refutes one of its central ideas”, a strong statement not substantiated by facts, evidence and reasoning.

In AK’s own view, “The stronger test results reported for equation (9), therefore, are the consequence of relaxing this restriction and so should be given less weight. That equation is our equation (14) for testing simple triangular PPP in its strong form, the result of which is the only one that does not confirm triangular PPP. We would like to thank AK for this opinion. When this specification is removed accordingly, triangular PPP in its strong form is confirmed by all the measures.

It is clear that it is groundless for AK to claim “Moreover, some of the empirical evidence presented in support of the triangular PPP actually refutes one of its central ideas” and/or “Third, WL’s econometric results do not provide particularly strong support for the hypothesis and, in fact, at least one result represents evidence against its central idea”. One of AK’s own opinions in fact contributes to the rebuff of his claims, albeit marginally as they are resolutely rejected already.

References
